it. The style of the whole book leads one to doubt the author's claims as a botanist to write it, and though it it may be a suitable guide to those who have to acquire a knowledge of botany in the course of their studies, it is practically useless for the rearing of botanists. Though one is reluctant to attribute a wrongly-spelt word to other than the conveniently necessary printer, the occurrence of Felicineæ, not once, but regularly, and, moreover, in the boldest and most conspicuous type of the headings of sections, does tempt one to think that the printer's fault lay in not having corrected it. A detailed criticism of the book would exhibit the author's imperfect acquaintance with the types discussed and his errors in description. Such, however, is beyond the scope of this notice.

## LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*]

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.*]

### A Plant which destroys the Taste of Sweetness

DURING his tenure of office as Governor of Madras, Sir Mountstuart Grant Duff found time, in a way at which I never ceased to marvel, to correspond with this establishment about every kind of detail connected with the botanical productions of Southern India. In one of the last letters which I received from him at the close of last year, before his departure from India, he writes:—"I send you inclosed in this a portion of that delightful plant *Gymnema sylvestre*, an Asclepiad. I shall be curious to know whether when it gets to you it retains the very interesting property that, if you chew carefully two or three leaves of it, it absolutely abolishes for the time the power of tasting sugar. This is no fable, for three of us, I being one, tried it this morning at breakfast with the most complete success. I ate pounded sugar after it without the faintest perception of its saccharine character. I also drank coffee without any sugar in it, and tasted it just as well as I ever did.

"General Elles has just been up to my room to tell me that he also found it abolish the power of enjoying a cigar. Do try it, and report to me, when we meet, whether it stands the long journey. This Gymnema might conceivably be important medically."

We found that the leaves sent by Sir Mountstuart Grant Duff did retain the property he described in a marked way. I immediately wrote to Mr. Lawson, the Director of Public Gardens and Plantations, Ootacamund, to endeavour to procure some seed which we might grow at Kew, so as to obtain material for future experiment. In a letter received from him this morning he promises to do this when the fruit is ripe. He has, in the meantime, been so good as to inclose in his letter a paper by Mr. Hooper, the Government Quinologist, which appears to me to well deserve the wider publicity of the pages of NATURE.

The whole matter is a good illustration of the useful work which can be done by scientific men in distant parts of the Empire, which indeed could hardly be done in any other way.

W. T. THISELTON DYER

Royal Gardens, Kew, April 11

[Mr. Hooper's paper will be found on pp. 565–67.]

### Units of Weight, Mass, and Force

IT is not easy to follow Mr. Greenhill in his letter which appeared in NATURE of March 24 under the above heading. His main contention appears to be that "weight" connotes not "force" but "mass" in engineering formulæ. Surely it would be more correct to say that the primary idea among engineers is that of force, mass being of secondary consideration and being measured by means of force: the force most commonly referred to being that of gravitation, which is *the* force, *par excellence*, with which the engineer has to deal. And I think it would be impossible to find any ordinary engineering formula involving $W$ (which is generally supposed to stand for *weight*) in which $W$ does not mean gravitation force. Also, in formulæ which have nothing to do with gravitation, and in which $M$ (or *mass*) would naturally appear, the engineer puts $W \div g$ instead of $M$, so as to enable him to express it in terms of his unit of force, the weight of a pound. Thus, the kinetic energy of a moving body is $\frac{1}{2}Mv^2$ (where $M$ is its mass and $v$ its velocity), and is quite independent of its position in space. Engineers, however, who only care about bodies near the earth's surface, express the energy in terms of the merely local phenomenon, the weight or gravitation force acting on the body, which is sufficiently constant for their purposes, and write $\frac{1}{2}Wv^2 \div g$. There is consequently a struggle between engineers and physicists as to whether "*pound*," "*ton*," &c., shall connote the fundamental engineering quantity, namely, *weight*, or the fundamental physical quantity, namely, *mass*; and, naturally, neither side is very willing to give way. The easiest way perhaps would be for the physicists to give another name to the mass-unit, and leave engineers to the enjoyment of their use of the word "pound"; though meanwhile the word might very well connote either *mass* or *weight* (*i.e.* gravitation force) according to the context, the terms pound-mass and pound-weight being used when special clearness is desired. But do not let us, as Mr. Greenhill seems to desire, use weight and mass as synonyms, so losing the advantage of a good word for no good reason.

But Mr. Greenhill's most incomprehensible attack is on the formula $W = Mg$.

The equation means fundamentally neither more nor less than that the force of gravitation on any mass near the earth's surface gives, or tends to give, to that mass a constant acceleration called "$g$," and is to be measured by mass and acceleration conjointly, in accordance with Newton's second law, the fundamental law connecting force and motion. The symbol $=$ means "equivalent to," as it often does.

From this fundamental equation can be deduced special *numerical* equations by means of definitions of arbitrary standards. Thus a "poundal" is the force which will produce in a pound-mass an acceleration of a foot-per-second per second;

$$\begin{aligned} \therefore\ W(\text{in poundals}) &= M(\text{in pounds}) \times g(\text{in ft.-per-sec. per sec.}) \\ &= M(\text{in pounds}) \times 32, \text{ approximately,} \end{aligned}$$

this equation being merely a *numerical* equation deduced from the fundamental physical equation above. For $W$ (in poundals) means the ratio of the weight of a body to the force called a poundal, or weight per poundal, or $\dfrac{\text{weight}}{\text{one poundal}}$, and so is a mere number depending on the particular mode of measuring $W$: and similarly with the other quantities.

Again, a pound-weight is the force which produces in a pound-mass the acceleration $g$;

$$\therefore\ W(\text{in pound-weights}) = M(\text{in pound-masses}),$$

or *ambiguously*

$$W(\text{in pounds}) = M(\text{in pounds}),$$

which is another merely numerical equation, and of course also only an approximate one; as Mr. Greenhill incidentally shows by means of his hypothetical balance at the coal-pit.

Too much importance can hardly be laid on the radical distinction between a physical equation and the various numerical equations which by choice of special units can be deduced from it. This must be my excuse for dwelling so much on the above example. It throws light on the way in which the error cited by Mr. Greenhill in his last paragraph can creep in. Thus, if the mass of a body of weight $W$ is $W \div g$, it really follows that the mass of a body whose weight is $W$ pounds (*or*, less ambiguously, $W$ pounds-weight) $= W$ pounds-weight $\div g$; but by definition one pound-weight $\div g =$ one pound-mass, $\therefore$ the mass $= W$ pound-masses. In Mr. Greenhill's example $W$ is a mere number, and he shows the error caused by trying to insert it in a formula where $W$ means a weight.

In conclusion, if Mr. Greenhill insists on the abolition of the equation $W = Mg$, will he kindly say how he would symbolise the connexion between the force of gravitation on a freely falling body and the induced acceleration $g$? ALFRED LODGE

Cooper's Hill, March 30

### The Association's "Geometry"

As the President of the Association for the Improvement of Geometrical Teaching did me the high honour to mention with special approval my work on geometry in his remarks before the

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Association, printed in the twelfth Annual Report, 1886, I feel impelled, on at length receiving to-day, at this frontier outpost of scientific civilisation, a copy, long ordered, of the Association's "Plane Geometry," Part 2, to say a few words suggested by it, favouring accord in these fundamental matters.

The very first definition and first theorem show the glaring need in English for a word which the Germans have in *Strecke*. Such a word, meaning a piece of a straight line, is needed in the first definition, the definition of a circle, for all straight lines are infinite in size, and radii are pieces of straight lines, and not whole straight lines. This is unconsciously recognised, even in the first theorem, where for "piece of a straight line" the undefined word *distance* is used, inappropriate because of its association with ideas of measurement by a unit and length, and because of its different and confusing use in the phrase "shortest distance."

In the demonstration of this first theorem, "straight line" is used in its proper sense, though just before, in the first definition, it was bunglingly used in the sense here given to *distance*. For the part of a straight line between two definite points I have long used the word "sect," which, carried over to the sphere with the meaning part of the spherical line less than half, gives the key to two-dimensional spherics.

And this suggests another objection to the same first definition. It says a circle is a plane figure. Now one cannot even think of spherics without seeing how immeasurably better it is to define a circle as a curve. It will be so defined as soon as the student reaches analytics, so why have him learn something only to unlearn?

In the fourth definition we have an over-used word, "conjugate." Two arcs which together make a circle should be called *explemental*. Explement is a natural third to complement and supplement. Again *converse* is a term of logic, and does not mean what it is here used to mean, that is, *inverse*.

In the introductory remarks to the fourth book I think it is a mistake to call hunger, love, courage, talent, wisdom, *magnitudes*.

A magnitude is whatever can be added to itself, so as to double. The very first sentence says: "In this book the subjects of the propositions . . . are magnitudes in general;" but the whole treatment is founded upon *multiples*, and is only applicable where multiples can be made. Not only must we have an exact criterion of equality, we must be able to add without shrinkage.

A little farther on we meet the absurd statement, "Fundamentally, number is *counting*."

Now we know that counting is establishing a one-to-one correspondence between the individuals of an aggregate and of a standard group which was primarily the fingers. But a number is fundamentally a picture of an aggregate which for all counting purposes is as good as the aggregate itself—a picture consisting of a mark for each distinct individual in the aggregate, as III.; and then secondarily a symbol for that picture, as 3.

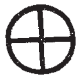
It is questionable whether Book IV. Part 1, has any valid excuse for existing. Proportion for commensurable magnitudes neither calls for nor warrants treatment by multiples. Sandeman, in the preface to his "Pelicotetics," speaks of "the phenomenon of incommensurability, through which alone arises any need of ratio, either the thing or the name." Euclid's marvellously elegant treatment of proportion is only admirable because of the difficulty it so deftly overcomes. To use it on commensurables is to use a Gatling gun on a plucked chicken. The illustration given under Definition 4 of this Part 1 (which definition needs the word commensurable inserted in it), "4 half-crowns = 5 florins," reminds one how badly England needs a decimal system of coinage, weights, and measures. No light is thrown on the compounding of ratios, but the error of A. J. Ellis is avoided. He says: "The ratio of B to A means the order in which the multiples of B are distributed among those of A."

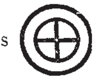
These are points suggested in first turning the leaves of a new book of most gratifying soundness. May it ward off from England the misfortune America now suffers, in that our most popular book on geometry makes the fundamental blunder of basing the treatment of parallels on direction, uses in its proofs the stultifying formula, "a straight line is the shortest distance between two points," and from one end to the other makes us wish for an American Association for the Improvement of Geometrical Teaching.

George Bruce Halsted

University of Texas, Austin, Texas, March 3

### The Svastika as both Sun and Fire Symbol

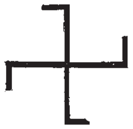
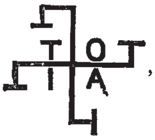
The late Prof. Dr. Worsaae ("Industrial Arts of Old Denmark") claims the ring-cross , as he terms it, as a sun symbol, and a small cup-shaped hollow for the moon; both these he places as belonging to the *later* Stone Age of Scandinavia, and, apparently, the only recognised emblems of that period. He observes, in one place: "How many hundred years, or, indeed, how many thousand years, before the Christian era the earlier Stone Age began, it is impossible to say."

The same writer places amongst the emblems of the *later* Bronze Age the wheel-cross  (the chariot wheel of the sun?). To this day, both in Denmark, Holland, and in parts of Germany, a wheel is frequently placed on the roof of a stable or other building, which is thus deemed protected from fire, especially if a stork can be induced to make its nest upon the wheel. The stork, owing to his red legs, was not inaptly considered an emblem of fire; he was also the herald of summer—he brought light and warmth. The Moqui symbol for the sun (as described by Dr. Dryer in NATURE, Feb. 10, p. 345) exists also on articles classed by Prof. Worsaae as belonging to the later Bronze Age in Scandinavia, with the exception of the three marks of which he speaks, as indicating the eyes and mouth of a face.

According to Hyde ("Persian Religion," p. 38), "Idolaters as well as sun-worshippers existed in ancient Persia, and the worship of fire and that of idols were combined at one period."

Quintus Curtius, when describing the march of the army of Darius (writing, however, long after date), says:—"Darius was accompanied by an image of the *sun*, placed in a crystal, and the sacred *fire* carried on a silver altar."

The sun, which was regarded as a wheel, a store of gold, an eagle, was also styled the eye of Varuna.[1] The worship of Mithra was likewise a worship of the sun; Mithra was the god of daylight. He and Varuna were fabled to journey at even in a brazen car. From this has probably arisen the horse-sun and the wheel-sun. Euripides gives the sun a winged car; and, on coins from Eleusis, Dêmêtêr is represented riding in such a car drawn by two serpents.

The *svastika*  has been very generally allowed to be a symbol of Thor, who, to the Scandinavians, was the god of thunder and lightning and of the domestic hearth, and therefore of fire also. The arrows in the hand of Jove, the thunderer of Roman mythology, resemble somewhat a compressed or crushed *svastika*. The above form of this symbol, with a very slight variation 

, may be seen on a slab taken out of a Christian catacomb in Naples, and now in the National Museum there. A very natural inference is, that this stone sealed the grave of one who had suffered martyrdom by fire.

The *svastika* has been held to be an emblem of fire, as being the way in which that element was first produced by primitive peoples—a method which is said to be in use in certain Hindú temples at the present day. It consists in two crooked sticks being laid one across the other, and a hole drilled through both; a pointed stick being there inserted, this is rapidly twirled by the hands until the five points of contact become ignited.

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[1] To the Persians, Varuna was the god of the clouds and of the celestial sea. When this branch of the Aryans reached Southern India, he there became to them the god of the earthly sea. To the Greeks he was Ouranos; and to the Germans and Anglo-Saxons, the eye of Woden.

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